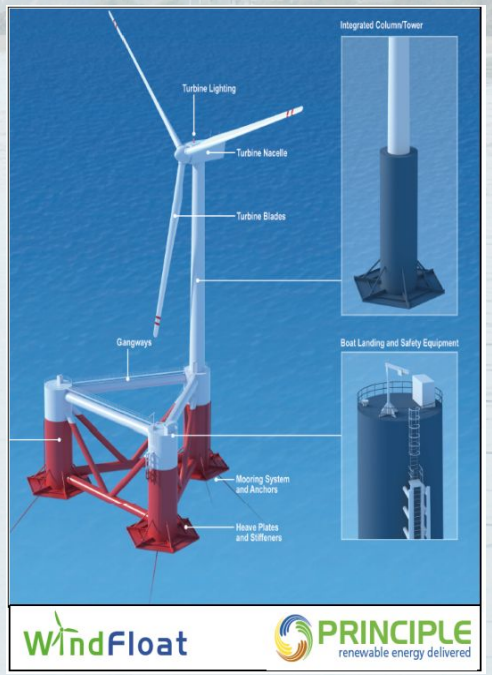
Gap Analysis: Marine Renewable Energy Environmental Effects on the U.S. West Coast

Oregon Marine Renewable Energy Environmental Science Conference

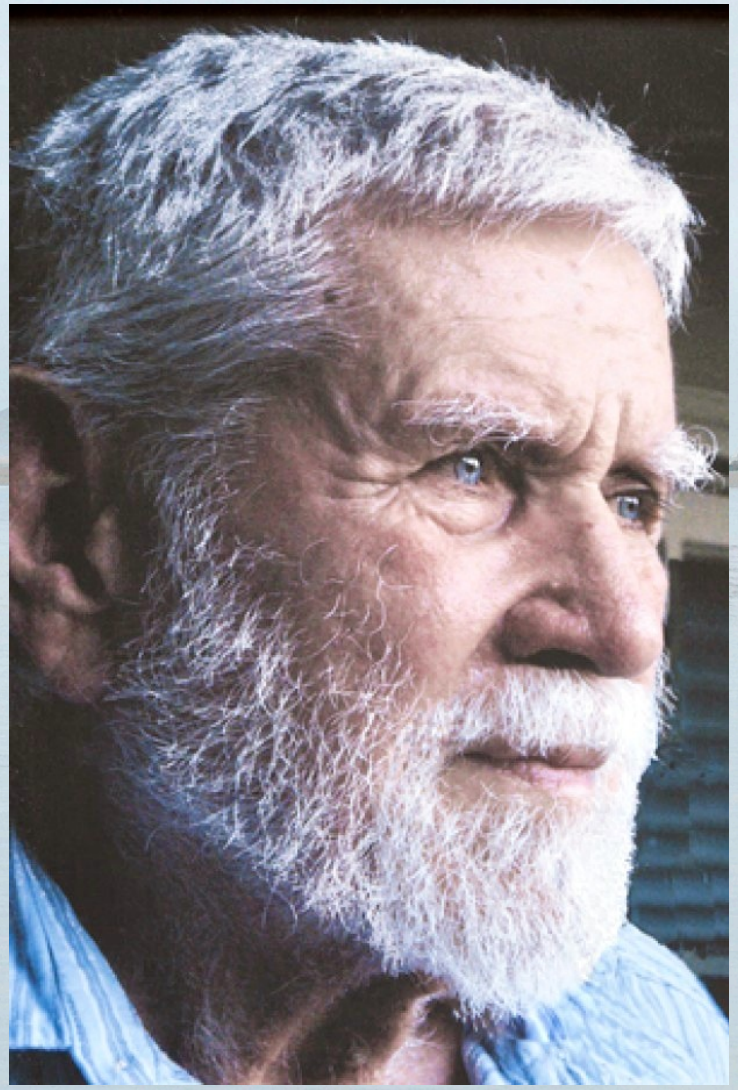
Corvallis, Oregon

November 28-29, 2012



Greg McMurray

Dr. W. Scott Overton



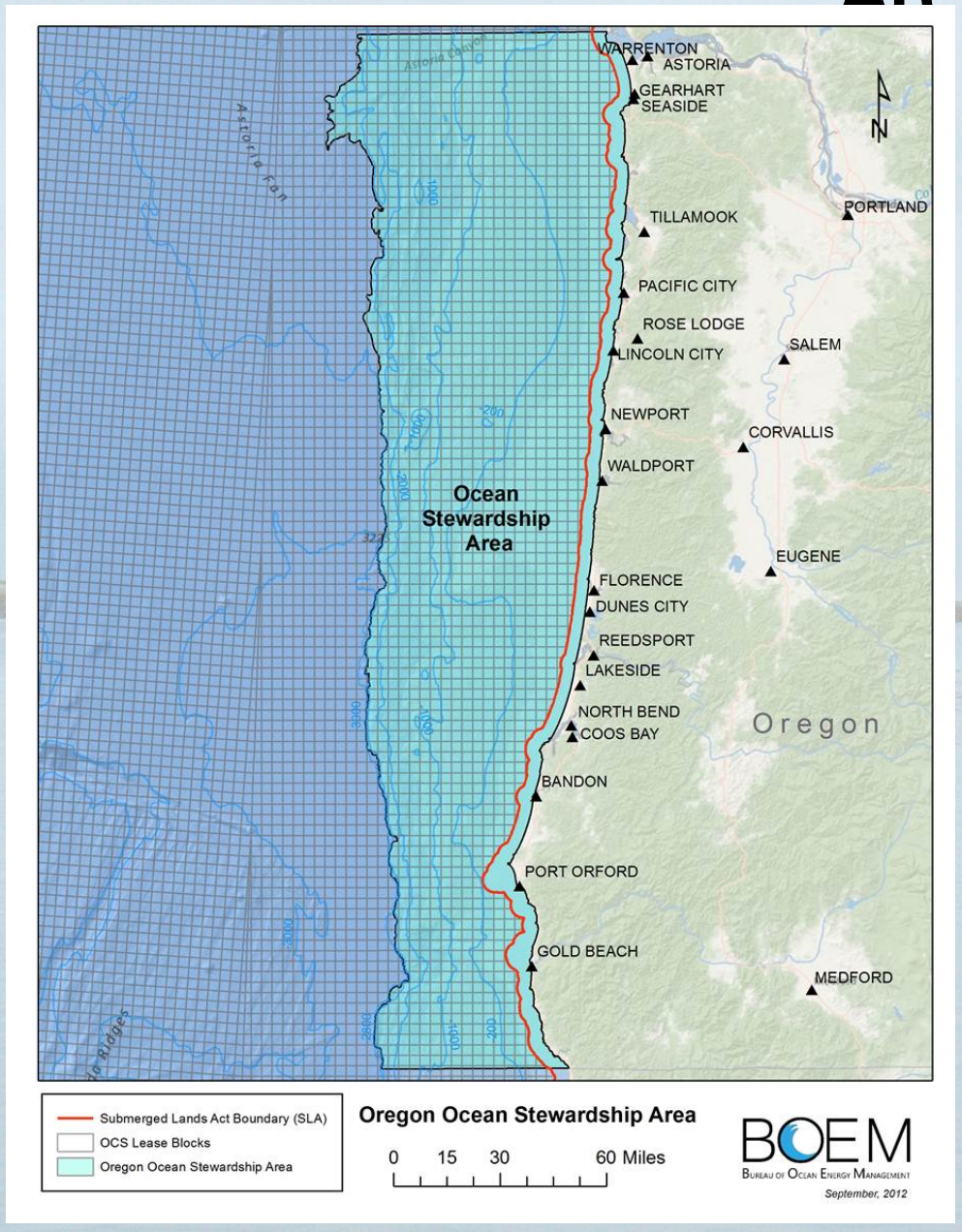
Why we're here; Why I'm here.

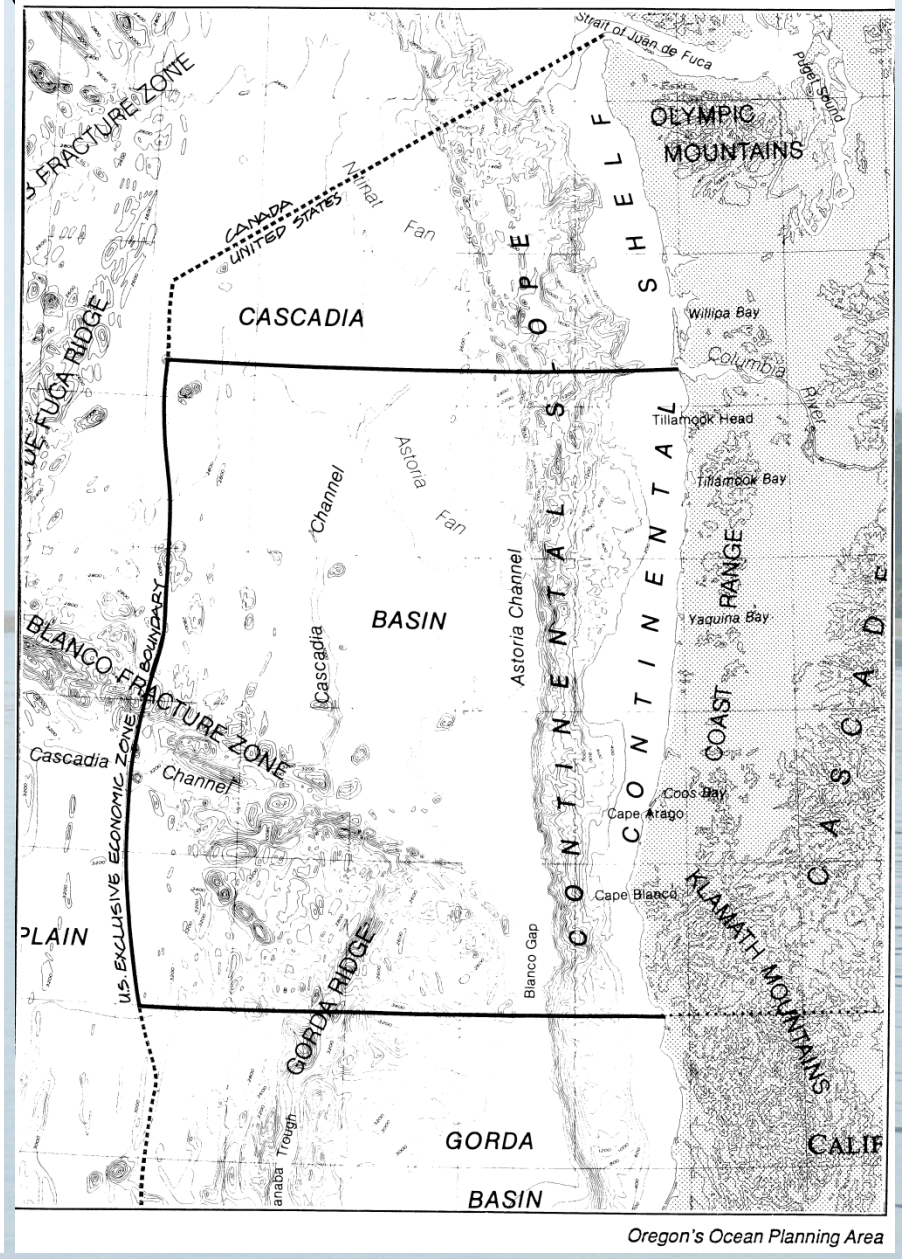
- The first goal is to showcase primary research that has recently taken place or is currently underway addressing environmental questions associated with wave and wind energy development in the Pacific Northwest.

- The second is to synthesize new research and existing information with the aim of distilling it into products that agencies and resource managers can use to carry out their planning and management duties.

- **The third goal is to identify gaps in our understanding of the technologies or potentially affected systems that then can be used for scientists, managers and funders to determine where to focus future research efforts.**

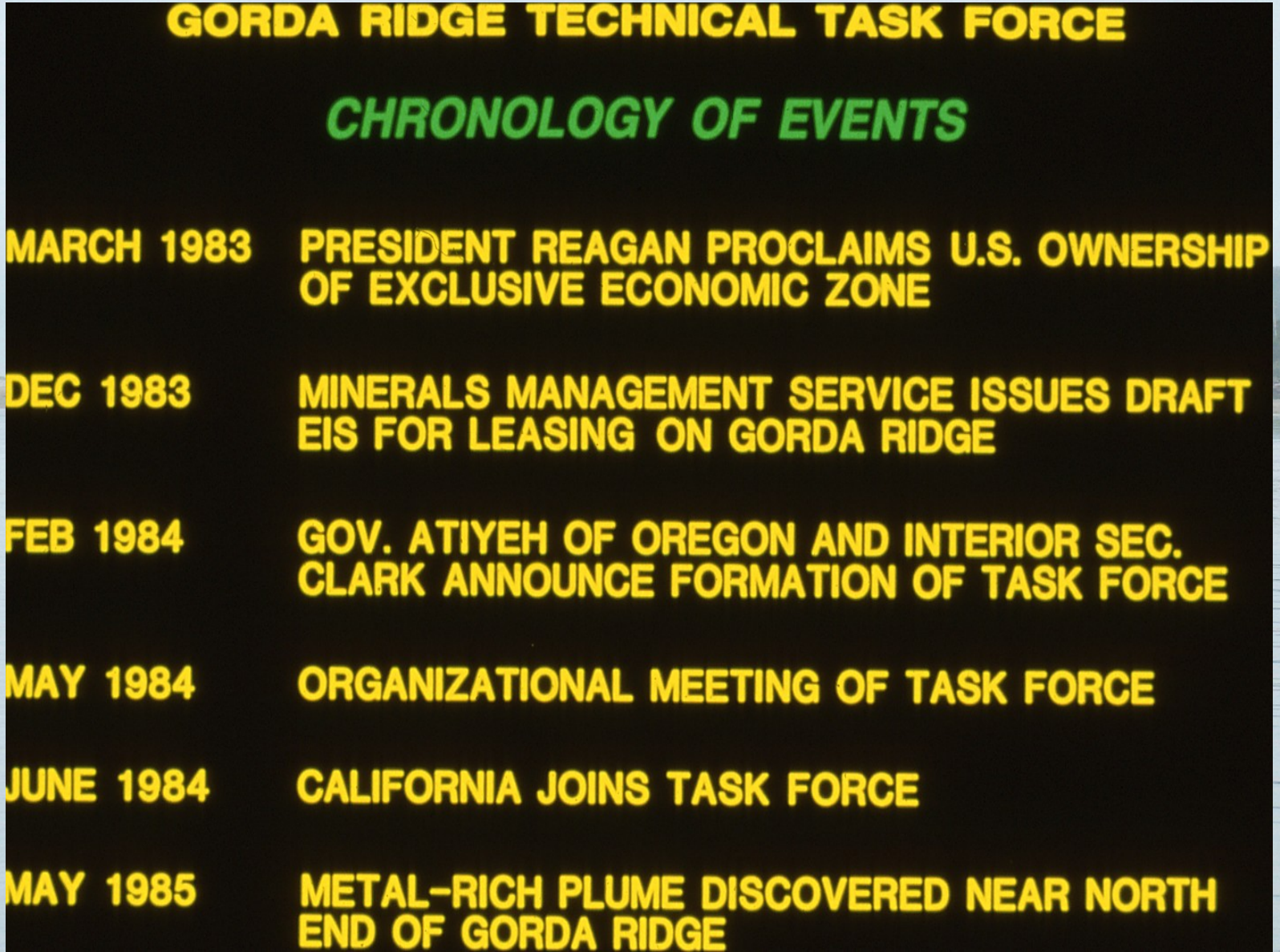
The US EEZ and the Oregon Ocean Stewardship Area



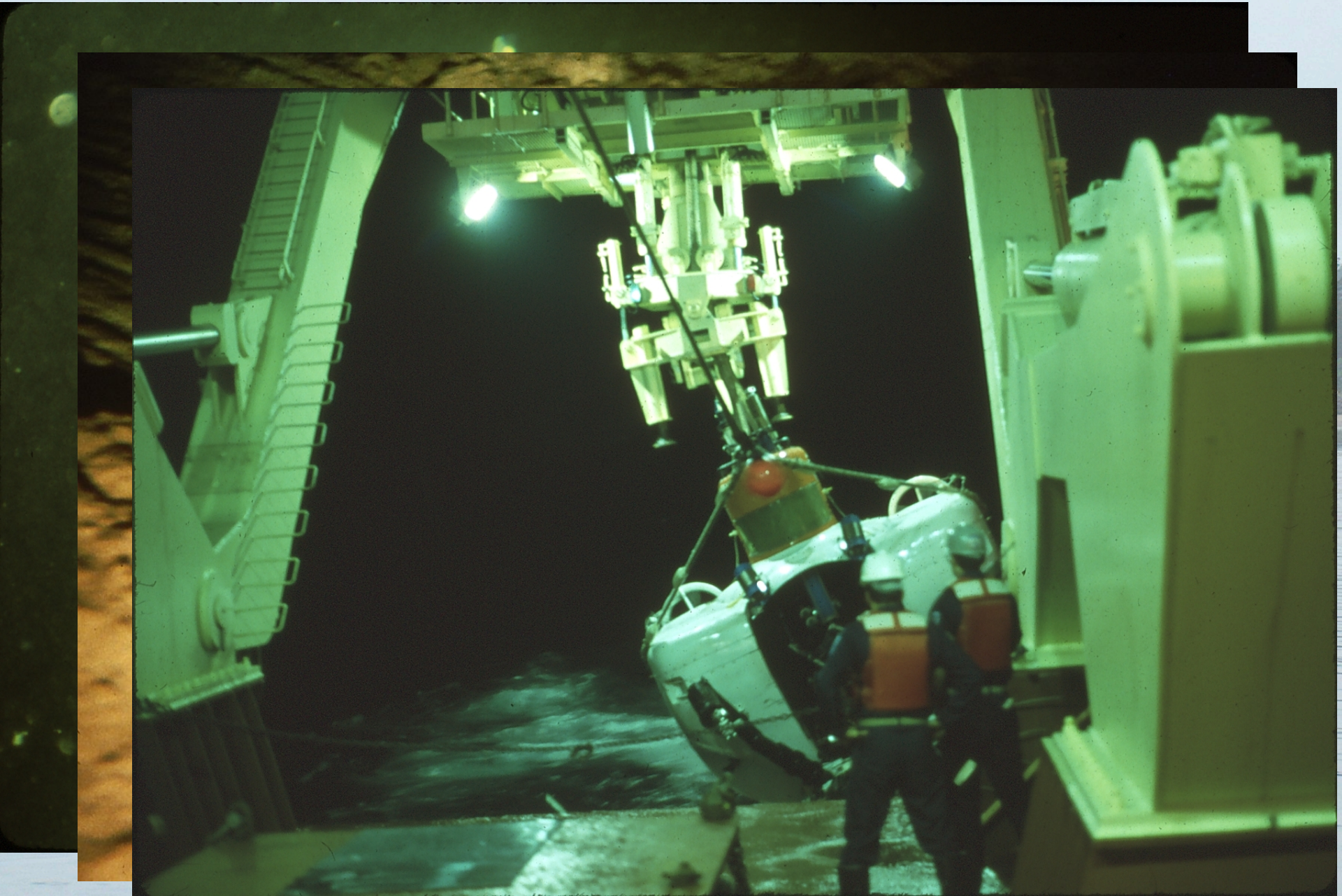


Oregon's Ocean Planning Area

A Little Historical Perspective……MMS was Unpopular in California and Oregon in 1984



GRTTF 1984-1989



Oregon Placer Minerals Technical Task Force 1990-1991: Proves the State Can Be as Unpopular as the Feds!

Ocean Wave Energy Facility Regulation: Integrated Management or Permitting Nightmare?

California and the World Ocean

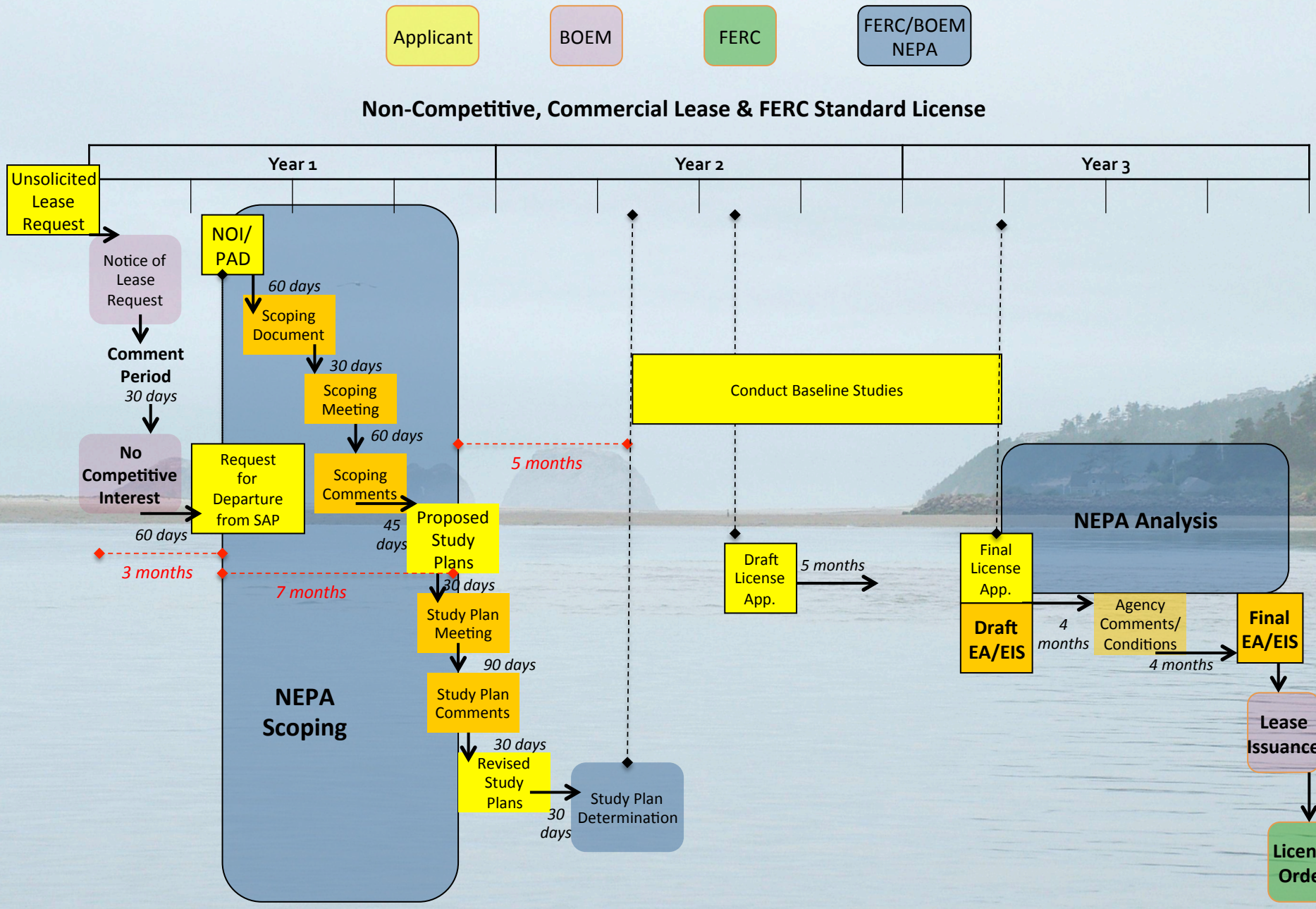
Long Beach, California, September 19, 2006

Greg McMurray
Oregon Coastal Management Program

Justin Klure
Oregon Department of Energy

Recommendations (CWO 2006)

- Plan towards a wave energy leasing regime that crosses the 3-mile zone
- Maximize leverage of state policy via mandatory authorities, especially through consistency
- Early scoping of environmental and user conflict issues
- Early and continual stakeholder involvement, especially existing ocean users
- Work towards prospective certification conditioning and adaptive management


Applicant
BOEM
FERC
FERC/BOEM NEPA
Non-Competitive, Commercial Lease & FERC Standard License
Year 1
Year 2
Year 3
Unsolicited Lease Request
Notice of Lease Request
Comment Period
30 days
No Competitive Interest
60 days
3 months
Request for Departure from SAP
NOI/ PAD
60 days
Scoping Document
30 days
Scoping Meeting
60 days
Scoping Comments
45 days
7 months
Proposed Study Plans
30 days
Study Plan Meeting
90 days
Study Plan Comments
30 days
Revised Study Plans
30 days
Study Plan Determination
NEPA Scoping
5 months
Conduct Baseline Studies
Draft License App.
5 months
Final License App.
NEPA Analysis
Draft EA/EIS
4 months
Agency Comments/ Conditions
4 months
Final EA/EIS
Lease Issuance
License Order

Whether the Issue Is Offshore Oil & Gas Development, Minerals Development, or Energy Development, the Oregon Stakeholders Are Many and Vocal

Please…

HELP US SAVE OUR FISHING COMMUNITY!

Oregon Fisherman have contributed billions of dollars to Oregon's economy.

OREGON Dungeness Crab COMMISSION

Oregon Dungeness Crab Commission
P.O. Box 1160
964 Central Ave.
Coos Bay, OR 97420

Phone: 541-267-5810
Fax: 541-267-5772
Email: hugh@oregondungeness.org

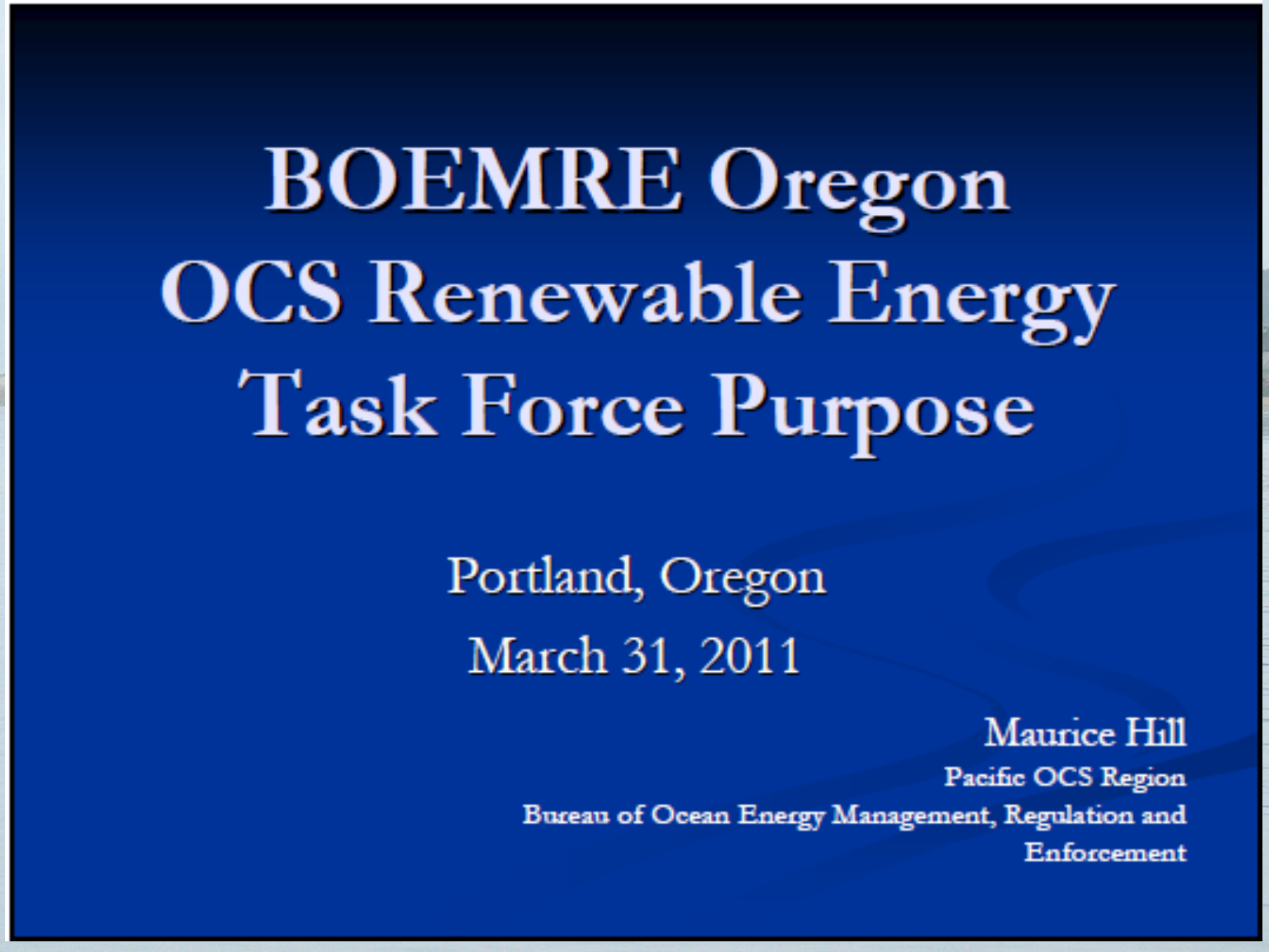
Oregon Fishermen need your help!

WAVE ENERGY
Is it FAIR?

The Oregon Dungeness Crab Commission asks you to

BE INFORMED

BOEM's Present Strategic Support, Planning and Cooperation Are Appropriate and Greatly Appreciated



Operational Definition –Gap

For practical purposes in this exercise, a gap may be defined as:

'a lack of information that, if available, would or could identify whether environmental effects will have sufficiently negative impacts to result in a "fatal flaw" in project design or siting when illuminated against the background of regulatory information needs for decision-making.'

The Basic Stressor-Receptor Matrix

	Stressor	Sediment characteristics	Water circulation (waves/currents)	Water chemistry	Nearfield habitat	Farfield habitat	Ecosystem interactions	Benthic invertebrates	Nektonic invertebrates	Plankton	Resident fishes	Migratory fishes	Elasmobranchs	Sea turtles	Cetaceans	Pinnipeds	Mustelids	Bats	Birds
		1	2	3	4	5	6	7	8	9	1	11	12	13	14	15	16	17	18
A	Static devices																		
B	Moving devices																		
C	Energy removal																		
D	Chemical release																		
E	Noise and vibration																		
F	EMF																		
G	Boat traffic																		
H	Lights																		

Wave Energy – Environmental Protocols Priority

	Stressor	Sediment characteristics	Water circulation (waves/currents)	Water chemistry	Nearfield habitat	Farfield habitat	Ecosystem Interactions	Benthic invertebrates	Nektonic invertebrates	Plankton	Resident fishes	Migratory fishes	Elasmobranchs	Sea turtles	Cetaceans	Pinnipeds	Mustelids	Bats	Birds
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A	Static devices																		
B	Moving devices																		
C	Energy removal																		
D	Chemical release																		
E	Noise and vibration																		
F	EMF																		
G	Boat traffic																		
H	Lights																		

= High Priority = Medium Priority = Low Priority = No Interaction

Wind Energy – Environmental Protocols Priority

	Stressor	Sediment characteristics	Water circulation (waves/currents)	Water chemistry	Nearfield habitat	Farfield habitat	Ecosystem interactions	Benthic invertebrates	Nektonic invertebrates	Plankton	Resident fishes	Migratory fishes	Elasmobranchs	Sea turtles	Cetaceans	Pinnipeds	Mustelids	Bats	Birds
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A	Static devices																		
B	Moving devices																		
C	Energy removal																		
D	Chemical release																		
E	Noise and vibration																		
F	EMF																		
G	Boat traffic																		
H	Lights																		

= High Priority

= Medium Priority

= Low Priority

= No Interaction

Key to Gap Table Symbols

Symbol	*Meaning*
(blank)	not considered an ecologically important interaction between stressor and receptors
A	an impact of this interaction is likely to result from an accident related to construction, servicing or extreme weather (and may be temporary)
E	data and information exist to inform the interaction
G	there exist significant gaps in our ability to assess this interaction
M	there exists known mitigation for this interaction
P	there exists information from other related activities that inform this interaction
S	the significance of this interaction is likely to be subject to the effects of scale
T	the effect or impact of this interaction is likely to be temporary; and
?	there exists significant uncertainty about the resource or the character of the interaction

Ocean Wave Energy – Data Gap Assessment for Siting and Construction

	Stressor	Sediment characteristics	Water circulation (waves/currents)	Water chemistry	Nearfield habitat	Farfield habitat	Ecosystem interactions	Benthic invertebrates	Nektonic invertebrates	Plankton	Resident fishes	Migratory fishes	Elasmobranchs	Sea turtles	Cetaceans	Pinnipeds	Mustelids	Bats	Birds
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A	Static devices	TP	TP		TP			TP										T	T
B	Moving devices	T	T		T			T											
C	Energy removal	TS																	
D	Chemical release			AT	AT			TE											
E	Noise and vibration										TM	TM	TM	TM	TM	TM	TM		TM
F	EMF																		
G	Boat traffic			TP	TP	TP	TP	TP	TP		TP	TP	TP	TP	TP	TP	TP		
H	Lights								TE		TE	TE	TE	TE	TE	TE	TE	EM	EM

Key:
A – Accident-related, E – Existing data, G – Data gap, M – Mitigation exists, P – Proxy data exist, S – Scaling effect?, T – Temporary, ? – Uncertain or Unknown

Offshore Wind Energy – Data Gap Assessment for Siting and Construction

	Stressor	Sediment characteristics	Water circulation (waves/currents)	Water chemistry	Nearfield habitat	Farfield habitat	Ecosystem interactions	Benthic invertebrates	Nektonic invertebrates	Plankton	Resident fishes	Migratory fishes	Elasmobranchs	Sea turtles	Cetaceans	Pinnipeds	Mustelids	Bats	Birds
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A	Static devices	TP	TP		TP			TP										TP	TP
B	Moving devices																		
C	Energy removal																		
D	Chemical release			AT	AT			TE											
E	Noise and vibration										TM	TM	TM		TM	TM			
F	EMF																		
G	Boat traffic			TP	TP	TP	TP	TP	TP		TP	TP	TP	TP	TP	TP	TP		
H	Lights								E		E	E	E	E	E	E	E	EM	EM

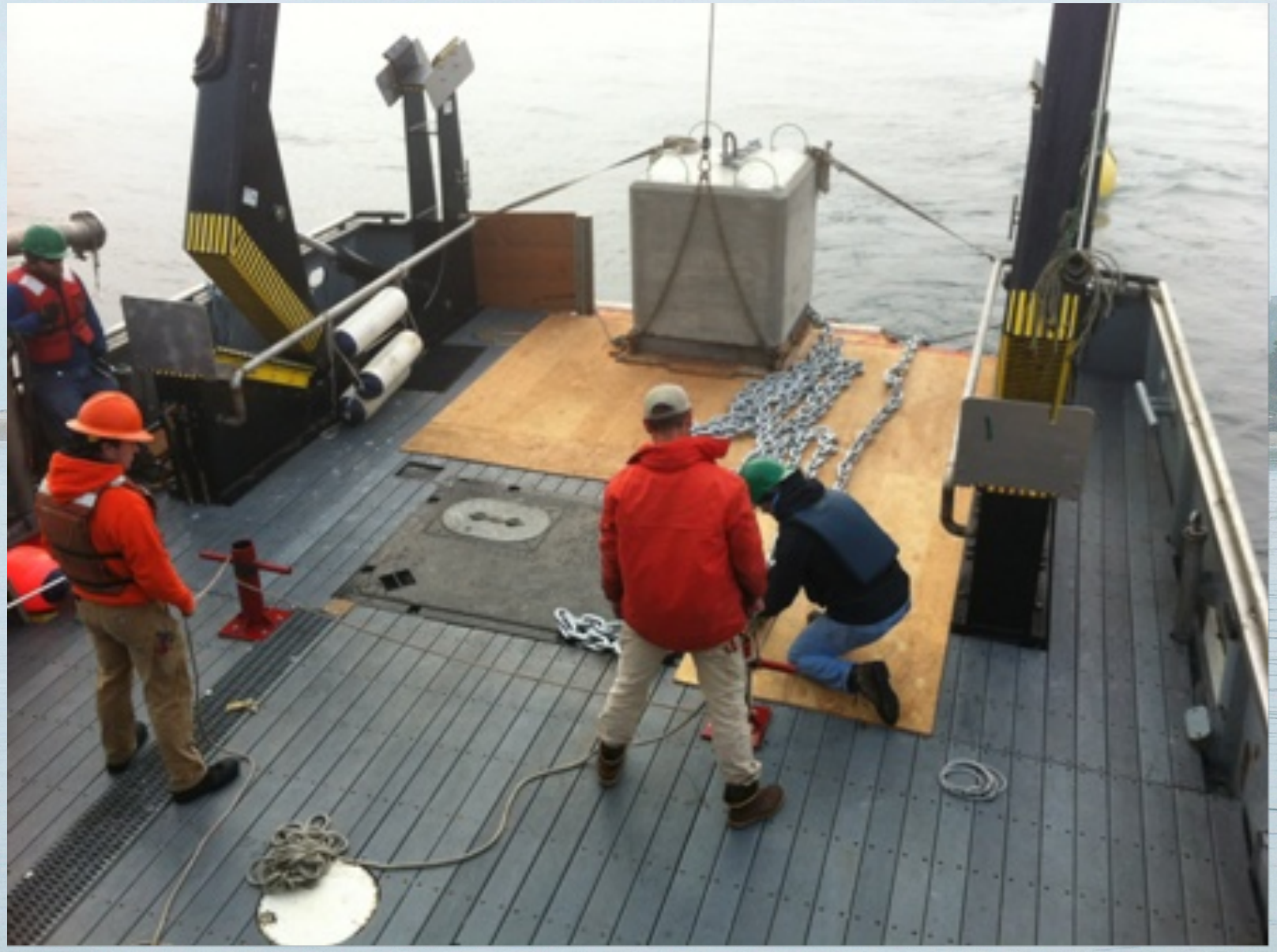
Key:
A – Accidents, E – Existing data, G – Data gap, M – Mitigation exists, P – Proxy data exist, S – Scaling effect, T – Temporary, ? – Uncertain or Unknown

OCS Service Vessels

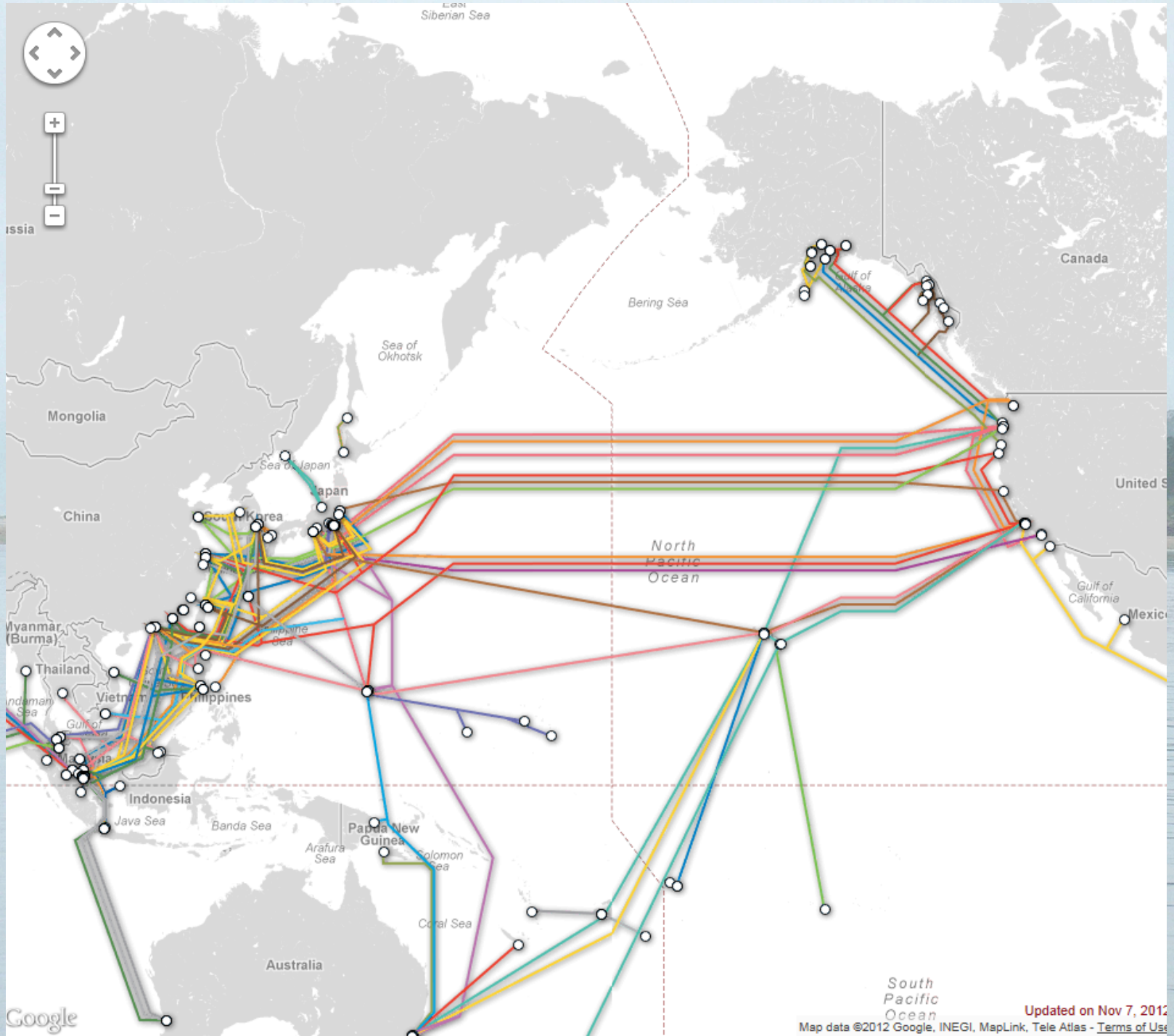
Heavy Lift Vessels – M/V *Blue Marlin*


DOCKWISE
BLUE MARLIN
DOCKWISE

Anchor Deployment for NNMREC *Ocean Sentinel*



Cable Trenching and Burying Vessel


East Siberian Sea
Canada
Bering Sea
Sea of Okhotsk
Mongolia
Sea of Japan
Japan
China
South Korea
North Pacific Ocean
Gulf of California
Myanmar (Burma)
Thailand
Vietnam
Philippines
Indonesia
Java Sea
Banda Sea
Arafura Sea
Papua New Guinea
Solomon Sea
Coral Sea
Australia
South Pacific Ocean
Google
Updated on Nov 7, 2012
Map data ©2012 Google, INEGI, MapLink, Tele Atlas - Terms of Use

Ocean Wave Energy – Data Gap Assessment for Operations and Maintenance

	Stressor	Sediment characteristics	Water circulation (waves/currents)	Water chemistry	Nearfield habitat	Farfield habitat	Ecosystem interactions	Benthic invertebrates	Nektonic invertebrates	Plankton	Resident fishes	Migratory fishes	Elasmobranchs	Sea turtles	Cetaceans	Pinnipeds	Mustelids	Bats	Birds
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A	Static devices	G			G	?S	GS								GS			?	GS
B	Moving devices									G				G	G	G	G		G
C	Energy removal	GS	GS		GS	GS													
D	Chemical release	S?		AT	AT		AT	S?		S?									
E	Noise and vibration				E	E					G	G	G	G	G				
F	EMF	P			P	P	G	G			G	G	G	G					
G	Boat traffic	E	E	E	E	E	E	E	E	E	E	E	E	E	EA	E	E	E	E
H	Lights								E		E	E	E	E	E	E	E	EM	EM

Key:
A – Accident-related, E – Existing data, G – Data gap, M – Mitigation exists, P – Proxy data exist, S – Scaling effect, T – Temporary, ? – Uncertain or unknown

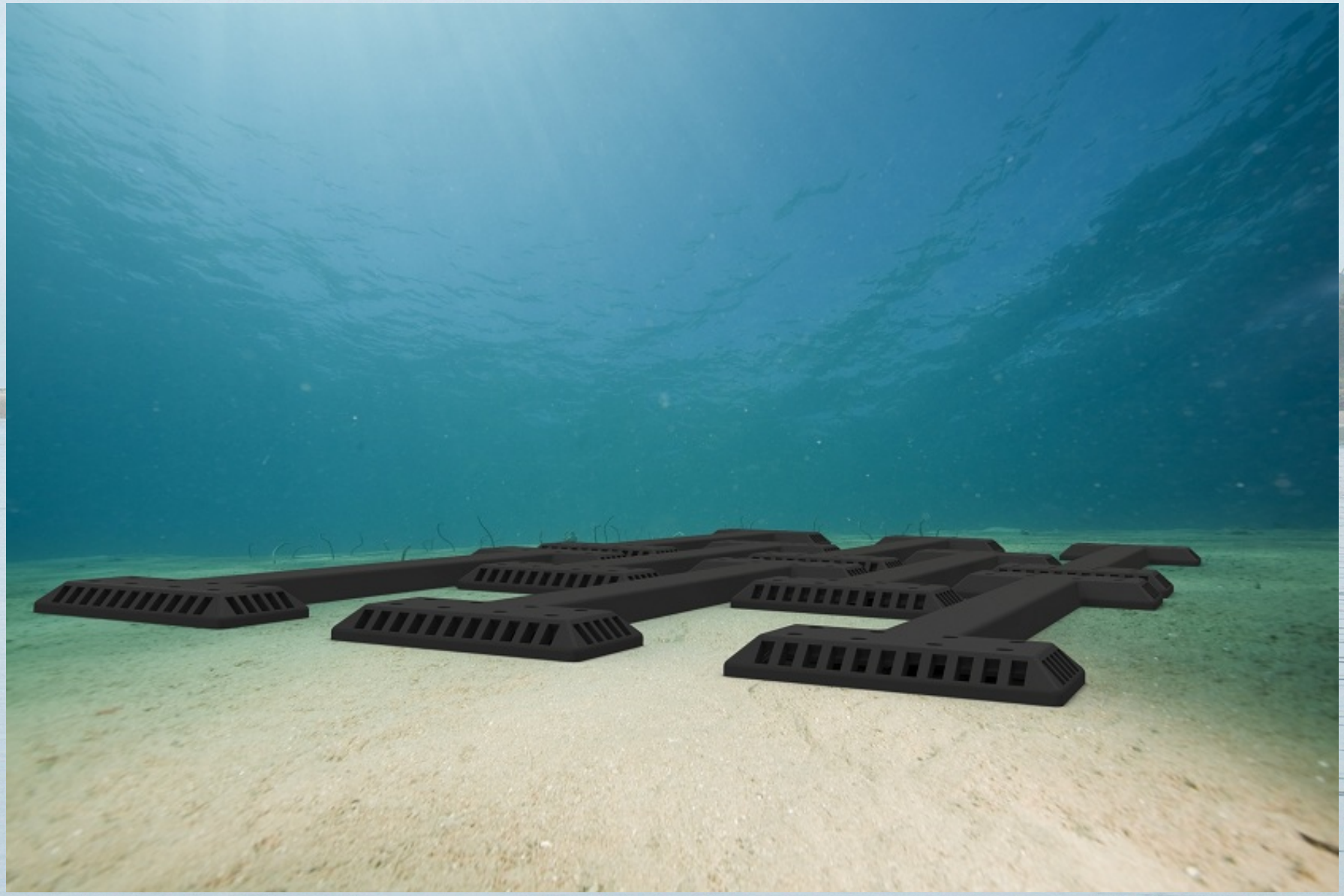
Offshore Wind Energy – Data Gap Assessment for Operations and Maintenance

	Stressor	Sediment characteristics	Water circulation (waves/currents)	Water chemistry	Nearfield habitat	Farfield habitat	Ecosystem interactions	Benthic invertebrates	Nektonic invertebrates	Plankton	Resident fishes	Migratory fishes	Elasmobranchs	Sea turtles	Cetaceans	Pinnipeds	Mustelids	Bats	Birds
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A	Static devices				G	S?	GS								GS			G	GE
B	Moving devices																	G	G
C	Energy removal	ES	ES		ES	ES													
D	Chemical release	S?		AT	AT		AT												
E	Noise and vibration				E	E					G	G	G	G	G				
F	EMF	P			P	P	GS	EM					G	G					
G	Boat traffic	E	E	E	E	E	E	E	E	E	E	E	E	E	EA	E	E	E	E
H	Lights								E		E	E	E	E	E	E	E	EM	EM

Key:
A – Accident-related, E – Existing data, G – Data gap, M – Mitigation exists, P – Proxy data exist, S – Scaling effect?, T – Temporary, ? – Uncertain or Unknown

WetNZ Buoy Deployed by NNMREC at Yaquina Head

M3 Wave's WEC Device Design



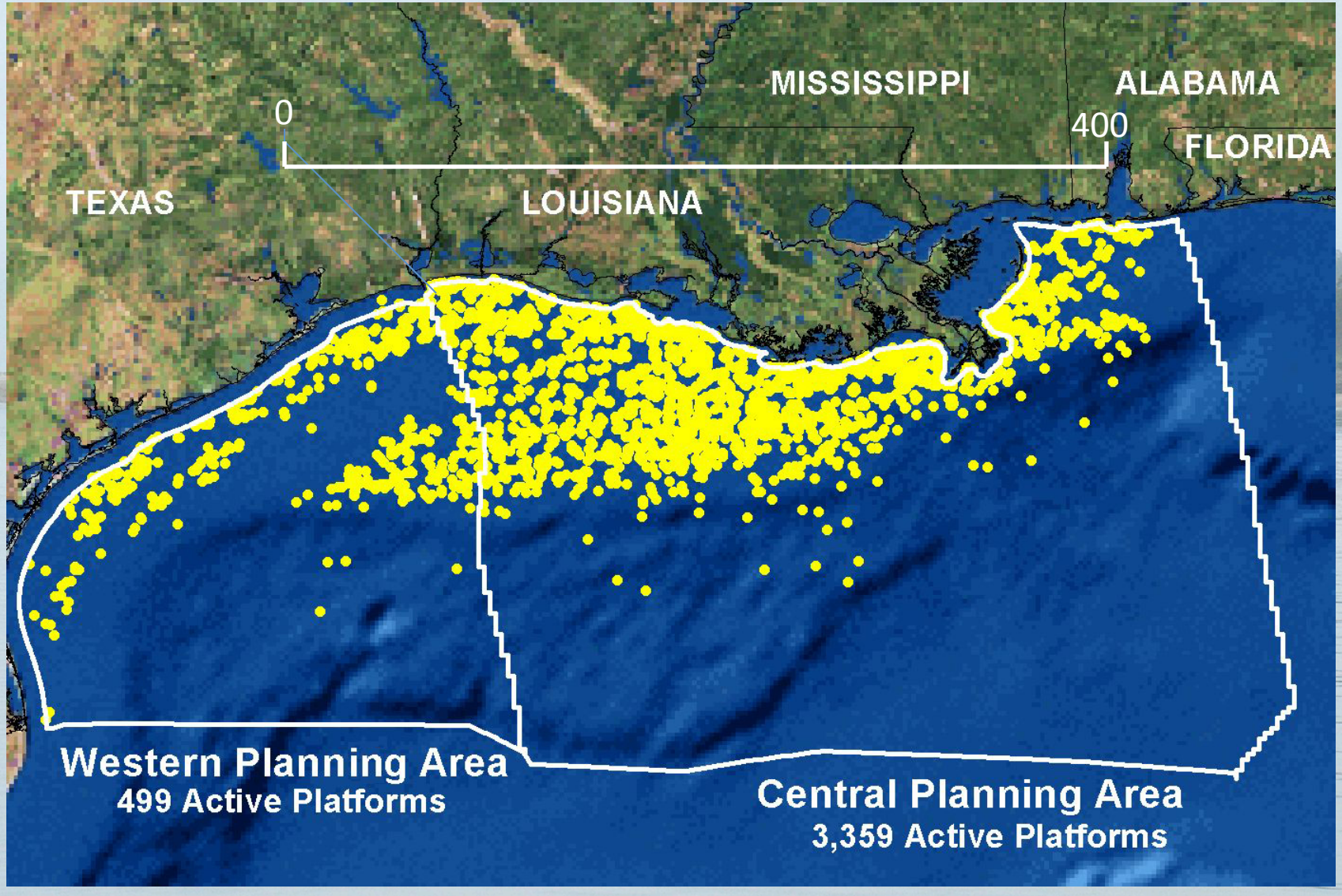
What do I mean by scaling?

I posit that there are two scaling thresholds for ocean renewable energy development:

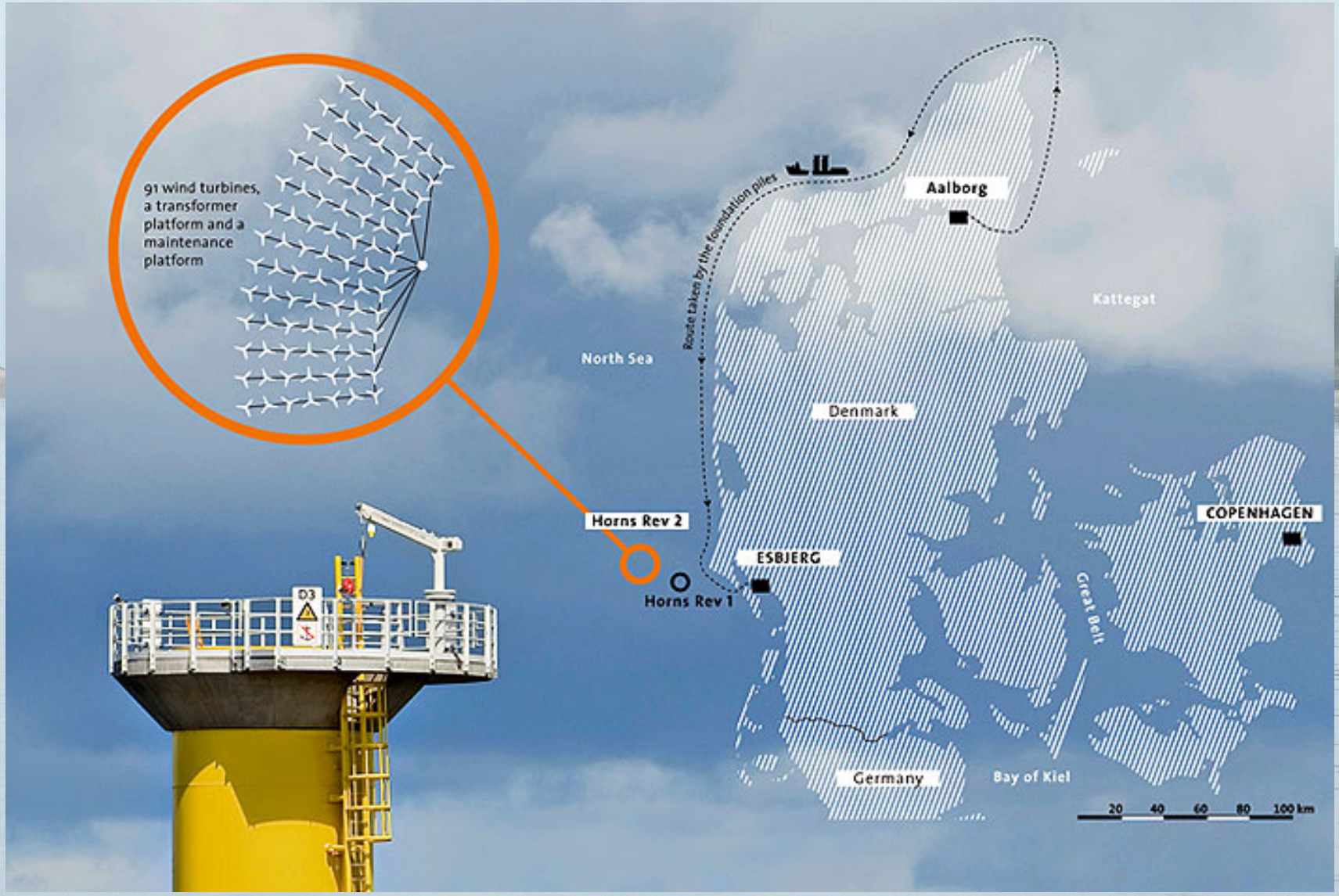
1. **The magnitude in area and density of devices that invokes unacceptable impacts; and**
2. **The number of arrays of a given area and density in a larger area that invoke unacceptable impacts.**
3. **Corollary: these must be evaluated in the time and space scales relevant to the ecosystem and its components and their levels of exposure.**

Density of OCS oil and gas rigs in the Gulf of Mexico

(Source: NOAA Explorer)



Horn's Rev spacing: 560 meters



Potential spacing for OPT Point Absorbers:

Original Coos Bay OPT Project:

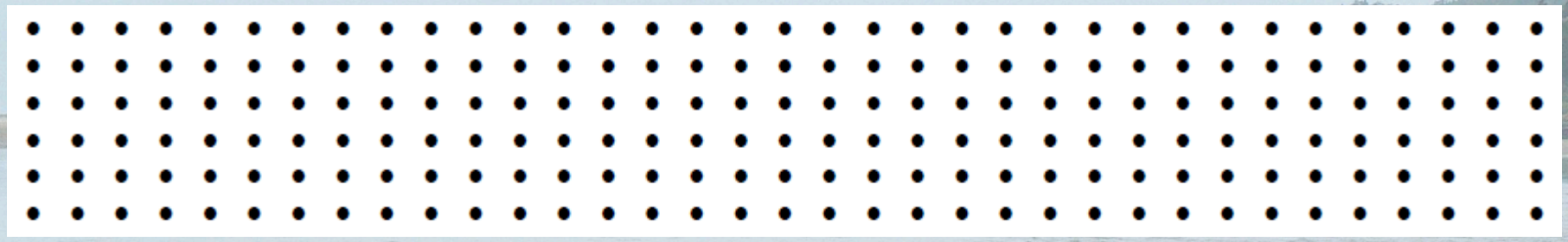
- **Preliminary permit for 1 x 5 mile area;**
- **Speculated 200 – 400 point absorbers;**
- **A very rough range of 150 – 400m between WECs**

……other technologies will vary…..

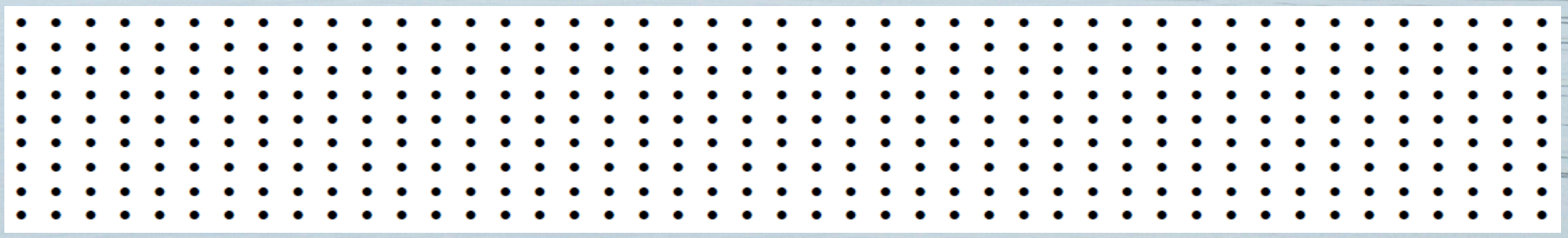
Potential WEC Densities at OPT's Coos Bay Project Under Existing FERC Preliminary Permit

Total project area: roughly 1.5 km by 7.5 km (1 mile by 5 miles), with 200 – 400 units

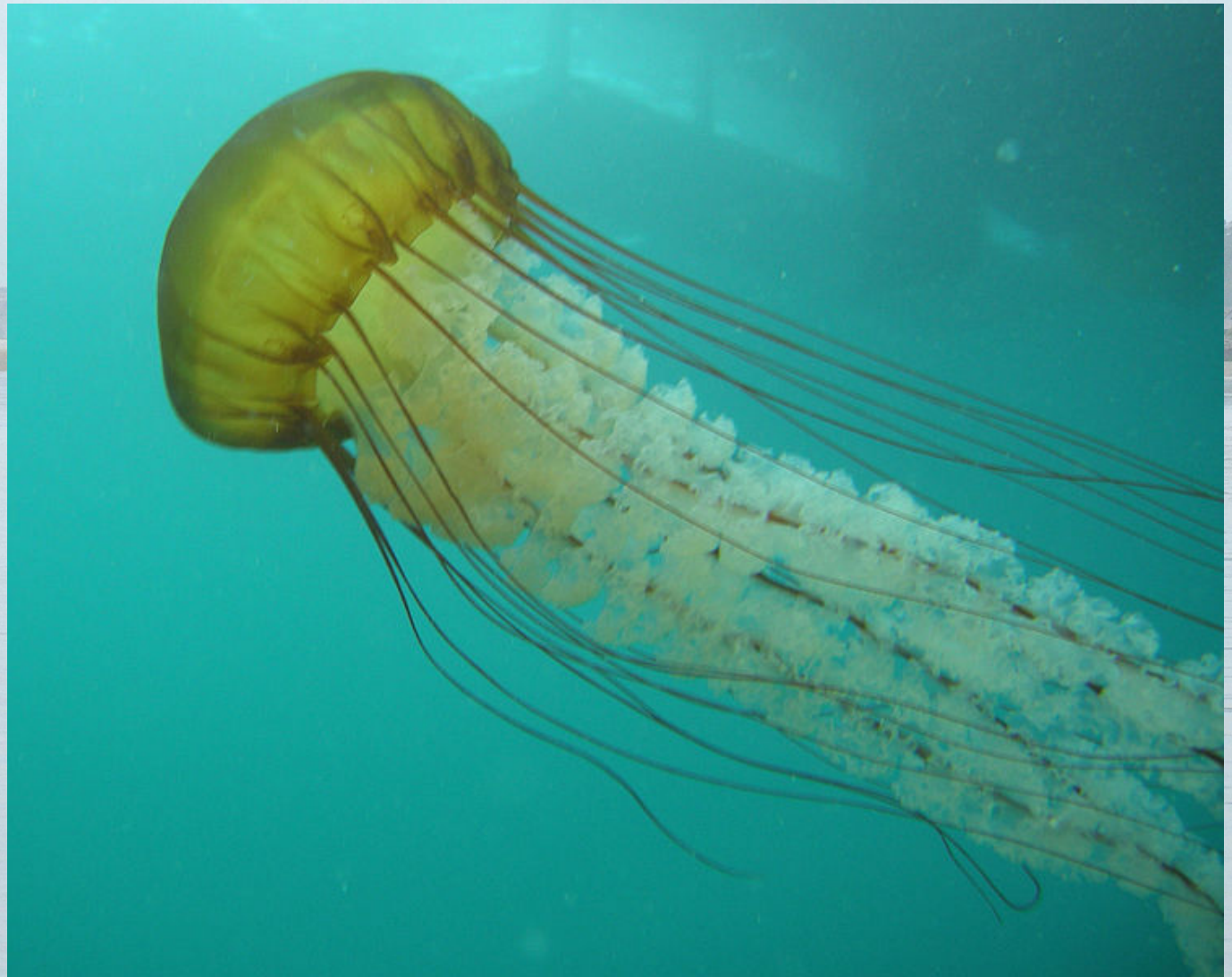
210 units: spacing roughly 250m by 214m



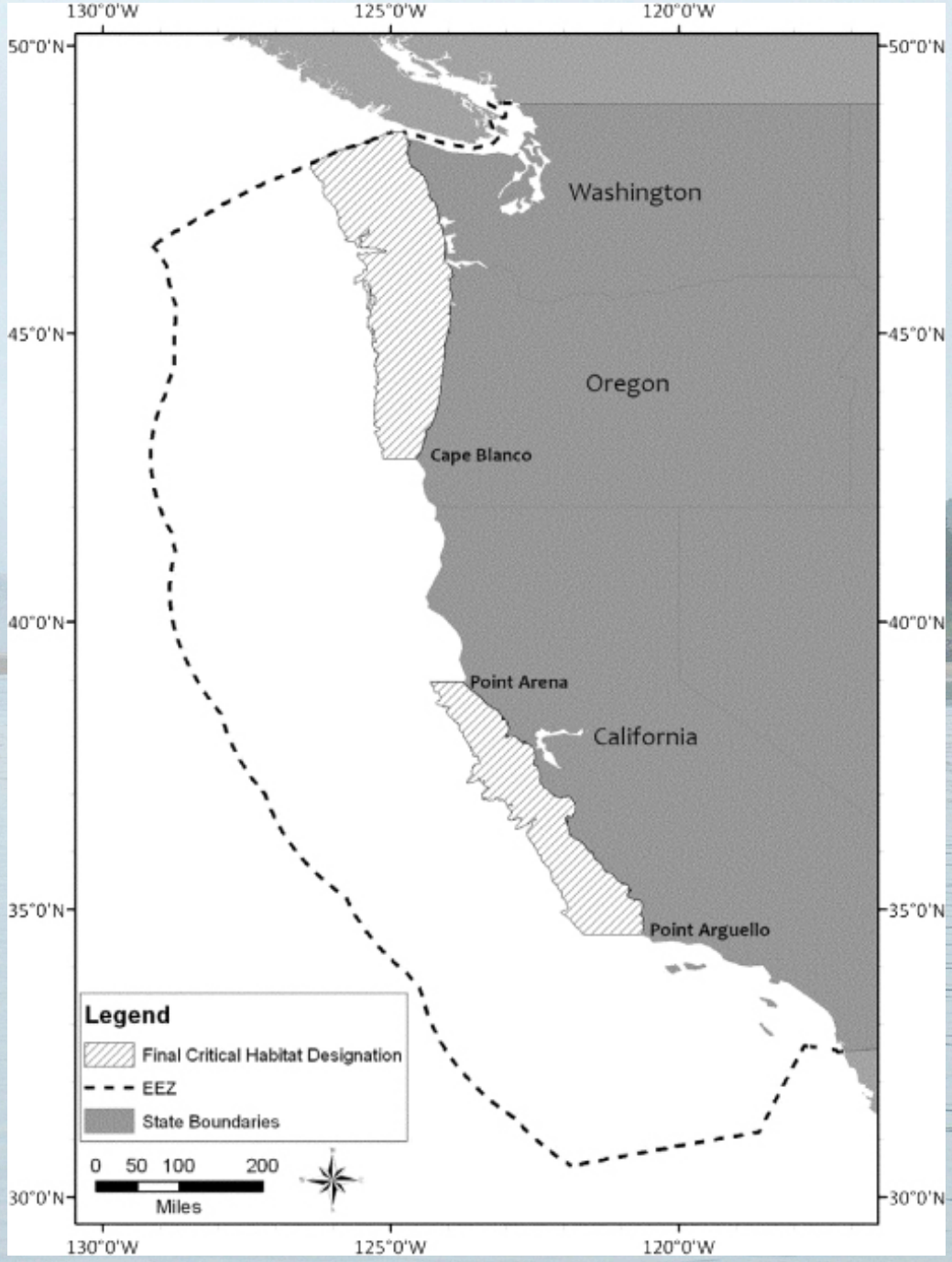
405 units: spacing roughly 167m by 167m



Brown Sea Nettle Is a Preferred Prey for the Leatherback Sea Turtle



Critical Habitat for the Leatherback Turtle is Based on Sea Nettle Distribution



Ecological Islands for Marine Invasive Species?

Ocean Wave Energy – Data Gap Assessment for Decommissioning

	Stressor	Sediment characteristics	Water circulation (waves/currents)	Water chemistry	Nearfield habitat	Farfield habitat	Ecosystem interactions	Benthic invertebrates	Nektonic invertebrates	Plankton	Resident fishes	Migratory fishes	Elasmobranchs	Sea turtles	Cetaceans	Pinnipeds	Mustelids	Bats	Birds
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A	Static devices	GE		T	T			GP			GE								
B	Moving devices																		
C	Energy removal																		
D	Chemical release			AT	AT			TE											
E	Noise and vibration										T	T	T	T	T	T	T		T
F	EMF																		
G	Boat traffic			TP	TP	TP	TP	TP	TP		TP	TP	TP	TP	TP	TP	TP		
H	Lights									TE		TE	TE	TE	TE	TE	TE	TE	EM

Key:
A – Accident-related, E – Existing data, G – Data gap, M – Mitigation exists, P – Proxy data exist, S – Scaling effect?, T – Temporary, ? – Uncertain or Unknown

Offshore Wind Energy – Data Gap Assessment Decommissioning

	Stressor	Sediment characteristics	Water circulation (waves/currents)	Water chemistry	Nearfield habitat	Farfield habitat	Ecosystem interactions	Benthic invertebrates	Nektonic invertebrates	Plankton	Resident fishes	Migratory fishes	Elasmobranchs	Sea turtles	Cetaceans	Pinnipeds	Mustelids	Bats	Birds
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A	Static devices	GE		T	T			GP			GE								
B	Moving devices																		
C	Energy removal																		
D	Chemical release			AT	AT			TE											
E	Noise and vibration										T	T	T	T	T	T	T		T
F	EMF																		
G	Boat traffic			TP	TP	TP	TP	TP	TP		TP	TP	TP	TP	TP	TP	TP		
H	Lights									TE		TE	TE	TE	TE	TE	TE	TE	EM

Key:
A – Accident-related, E – Existing data, G – Data gap, M – Mitigation exists, P – Proxy data exist, S – Scaling effect?, T – Temporary, ? – Uncertain or Unknown

BOEM Studies Show Similarities and Differences Between Fish Assemblages at Artificial and Natural Reefs

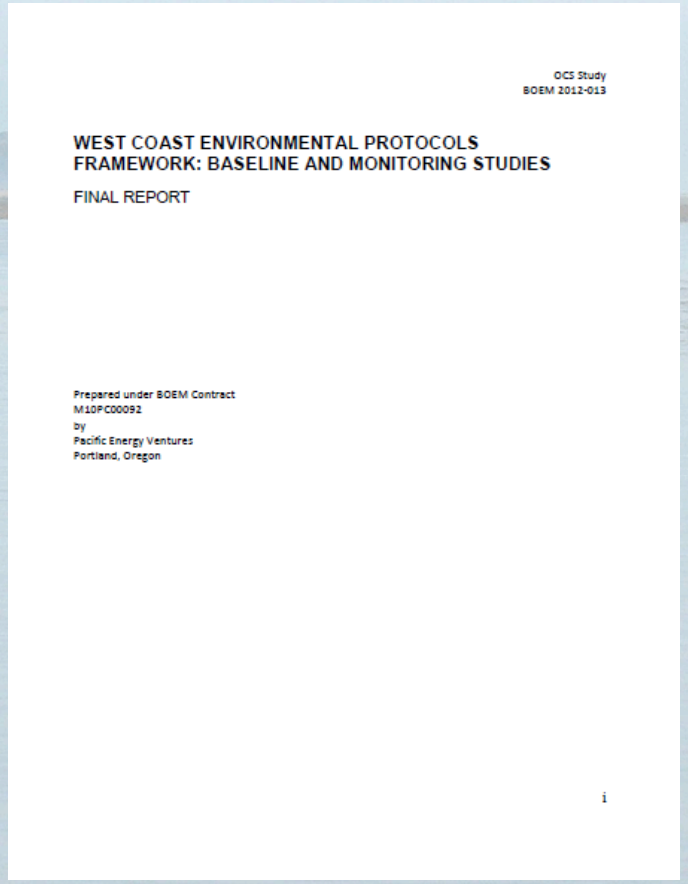
- **Studies from Love, Bull, Schroeder, Nishimoto and Yoclavich; synthesis by Love, Schroeder and Nishimoto**
  - **Studied mid-water, deep-water and shell mound assemblages**
  - **Growth rates of some fish may be comparable at natural and artificial reefs (e.g., YOY blue rockfish)**
  - **Assemblages similar at artificial and natural reefs, but with different species densities**
  - **Predation rates of some species may be higher at artificial reefs than at natural reefs (e.g., painted greenling)**
  - **Rugosity is important variable in habitat suitability for both**
  - **Heterogeneity of rugosity (i.e., interstices of difference sizes) is also important – thought to support a more diverse community**
  - **Active dialog on *production* versus *concentration* at artificial reefs**

Summary and Conclusions

- Technology-specific data for WECs
- Site-specific data for targeted planning or development areas
- Information on scaling effects on density of structures in arrays, and density of arrays in a locale
- Application of regulatory stringency per the risk to special status species and habitats
- Need for information sharing and use of active, well-maintained information nodes, accessible to everybody
- Adaptability of data for assimilation in ecosystem modeling and ecosystem management – e.g., CCIEA and CCAM

Collaboration Among States and Federal Agencies is Important

- **WA + OR + CA = WCGA……**
- **BOEM + NOAA + USDOE = NOPP……**



OCS Study
BOEM 2012-013

WEST COAST ENVIRONMENTAL PROTOCOLS FRAMEWORK: BASELINE AND MONITORING STUDIES

FINAL REPORT

Prepared under BOEM Contract
M10PC00092
by
Pacific Energy Ventures
Portland, Oregon

i

For background, news and other information see:

- Ocean Renewable Energy Knowledgebase at www.OceanRenewableEnergy.com

and

- Tethys at mhk.pnnl.gov/wiki/index.php/Tethys_Home

Thank you!

Some Dialogue?

BOEM
Bureau of Ocean Energy Management

pacific ENERGY VENTURES

Pacific Northwest
NATIONAL LABORATORY

NNMREC
Oregon State University
University of Washington